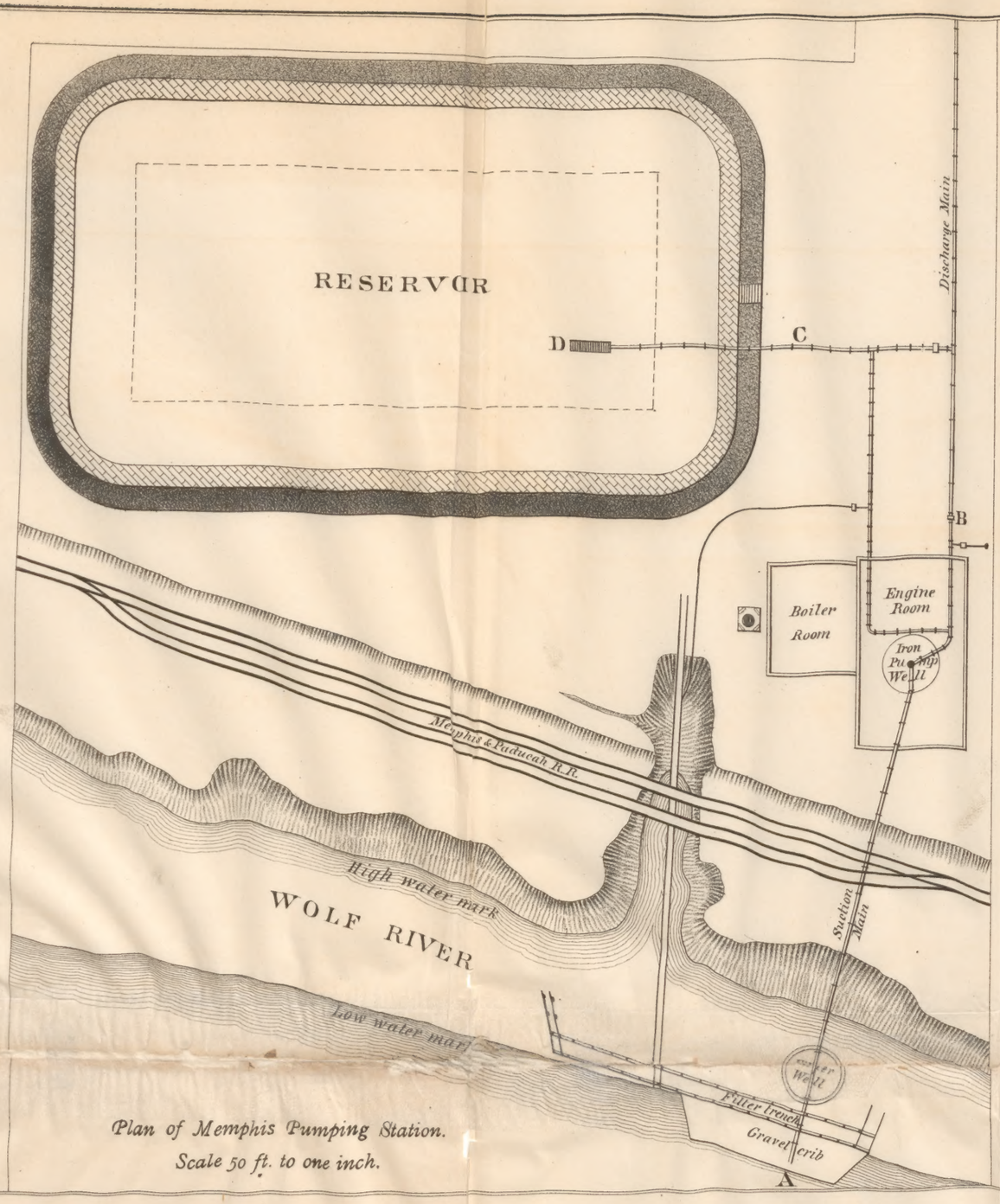
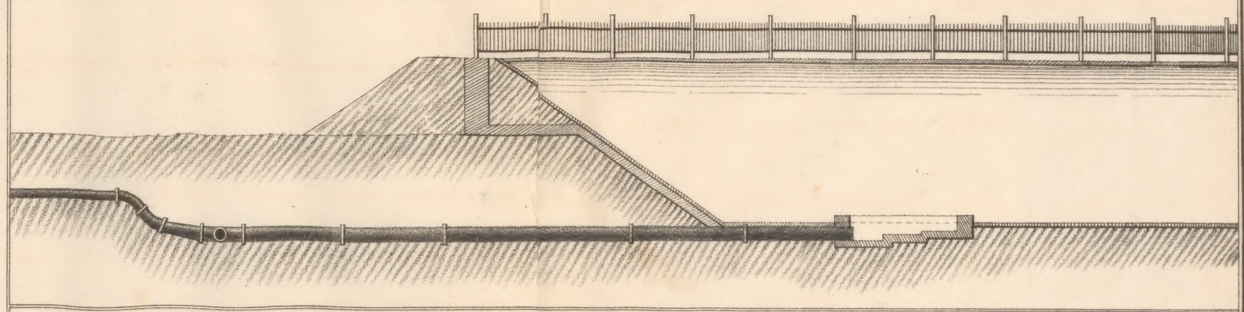


Plan of Memphis Pumping Station.
Scale 50 ft. to one inch.

Section showing Reservoir Embankment, Puddle Walls, and Main Discharge Pipe.
(Section of line C. D. in plan.) *Scale 16 ft. to one inch.*



Plan and Elevation

OF THE

Memphis Water Works,

Grounds and Pumping Station.

Vertical Elevation of Pumping Station, Memphis Water Works, showing outer Gravel Crib, Filter Well, Suction Main, Tunnel, Iron Well, Pumps, Machinery and Engine Building, following line A.B. in plan.

Scale 16 feet to one inch.

Drawn by G. W. Pearsons, Engineer.

Ehrgott & Krebs Lith. Cincinnati

Drawn by G.W. Pearsons.

Ehrgott & Krebs Lith. Cincinnati.

MEMPHIS WATER WORKS.

5

ANNUAL REPORT

OF THE

BOARD OF DIRECTORS

TO THE

STOCKHOLDERS

OF THE

Memphis Water Company,

APRIL 30th, 1873.

MEMPHIS:
S. C. TOOF, PRINTER AND BINDER, 15 WEST COURT STREET.
1873.

OFFICERS

AND

BOARD OF CONSTRUCTION.

PRESIDENT,	JOHN CUBBINS.
TREASURER,	CHAS. J. PHILLIPS.
SECRETARY,	W. L. CAMERON.
FINANCIAL AGENT,	F. M. MAHAN.
SOLICITOR,	O. P. LYLES.
CONSULTING ENGINEER,	A. R. KETCHAM.
CONSTRUCTING ENGINEER,	G. W. PEARSONS.
SUPERINTENDENT OF STREET MAINS,	M. G. RILEY.

BOARD OF DIRECTORS.

JOHN CUBBINS. JOHN S. TOOF. B. C. BROWN.

F. M. MAHAN. J. H. HUMPHREYS.

JOHN E. RANDLE.

PRESIDENT'S REPORT.

OFFICE OF THE MEMPHIS WATER COMPANY,
April 30th, 1873.

To the Stockholders of the Memphis Water Company:

The report of the President and Board of Directors required by the Charter of this Company to be made annually, has been deferred until this time to give the Engineer and Secretary time to prepare and submit their reports, without which no satisfactory statement of the condition of the Company could have been made. These reports and statements would have been prepared and submitted at an earlier day, but for the fact that all the officers named, and indeed all the officers of the Company, were, during the last few weeks prior to your annual meeting, so constantly engaged in completing the construction of the works that no time could be spared by any one for the preparation of a report. At the annual meeting held in March, 1872, no report could be made, except that a contract for the necessary machinery had been made with the Holly Manufacturing Company, of Lockport, New York, and that another contract for hydrant service and rent had been made with the city of Memphis. With the details of these contracts you are familiar.

At that time, the outlook for success was anything but encouraging; with the exception of the closing the contracts mentioned, nothing had been done, and in contemplating the magnitude of the work before us, we felt that our positions were anything but pleasant. Authorized by you to do so, the President and Board of Directors executed a mortgage to secure six hundred thousand dollars of the bonds of the Company, and caused such bonds to be prepared, executed and placed upon the market. With them as a basis, Mr. F. M. Mahan, the excellent financial agent of the Company, has, by his energy and ability, succeeded in raising all the money necessary to keep the work constantly in progress, and to meet all obligations of the Company at their respective maturities. To him the Company is largely indebted for its success.

The necessary funds having been secured, active operations were immediately commenced, and as a result we have the pleasure of announcing that your works are in successful running order; that the tests required by the contract with the city of Memphis have been fully and successfully met, and the ability of the works to successfully perform the service required demonstrated to the satisfaction of the city authorities; that upwards of seventeen miles of pipe have been laid; that applications for private supplies of water to citizens have been and are being made so rapidly and in such number as to task the utmost energy of every employee of the Company in making connections, and that in every point of view the Memphis Water Company is an assured success.

For details of construction, description of the works, and other matters of interest, you are referred to the reports of the Engineer and Secretary which are herewith submitted.

The President and directors feel that they would be doing injustice did they not in this report call attention to the merits and demand acknowledgment from you of the services rendered to the Company by the resident constructing engineer, Mr. G. W. Pearsons. To his energy, industry and great ability much of our success is due;—his labors have been tireless and he has shown himself to be a master of his profession, while our personal intercourse has been so pleasant that our gratification at the mere completion of our works is alloyed by regret at the necessity of parting with him—a necessity only produced by that completion.

In our choice of a Secretary, we have been equally fortunate. Mr. Cameron is too well known in Memphis to require any endorsement from us, but we desire to acknowledge the indefatigable industry with which he has always discharged the duties of the office and the constant courtesy and kindness shown in his manner to all having business with him.

Mr. Charles J. Phillips has shown himself in every way competent to discharge the duties of Treasurer, and it is with pleasure that we announce that both he and Mr. Cameron will continue in the service of the Company during another year at least.

The rapidity with which your works have been pressed forward has tasked every one connected with the Company to the utmost; but without exception, every duty has been cheerfully performed.

Respectfully,

JOHN CUBBINS, *President.*

Extract from the minutes of the Stockholders' meeting, held March 4th, 1873:

* * * * * * * * * * * *

A vote of thanks of the Stockholders to Mr. John Cubbins, President, for the untiring zeal, time and attention bestowed by him upon the works of this Company while under progress, and the Stockholders congratulate Mr. Cubbins upon the successful and workmanlike character of all work done under his administration during the past year.

* * * * * * * * * * *

A true copy from the minutes:

W. L. CAMERON, *Secretary.*

ENGINEER'S REPORT.

OFFICE OF THE MEMPHIS WATER COMPANY,
February 28th, 1873.

To the Honorable President and Board of Directors of the Memphis Water Company:

In presenting my report, with that of your Secretary, on the construction of the Memphis Water Works, it has been thought best, as a matter of interest to the public, to preface it with some remarks on water supply.

For the scientific data appended, we are indebted to the able report made in 1868 by the Commission organized by the city for the study of the questions of water works and sewerage. This Commission made elaborate surveys and estimates for both subjects, and caused analyses of various samples of water, taken from different proposed sources of supply, to be made.

We have quoted in these pages the portions directly bearing on this subject.

These estimates, which were based on the use of the reservoir system, and with a view to the subsidence of the water to a state of clearness in the reservoir, involved an expense of construction which the city was not at the time able to meet, and the question of water supply, which had been for years a source of study and effort, both by the city and by citizens, seemed again likely to be indefinitely postponed.

The question being again taken in hand by private citizens, who had learned by practical experience the value of Wolf River as a source of water supply, the question of reducing expense by the use of water without subsiding reservoirs was studied, and with satisfactory results.

The amount of water storage demanded for the purpose of subsidence, and the great cost of constructing adequate reservoirs for it, shows first that the decoloration of any water to be obtained

in this section of country is a thing very hard to be effected, and brings us directly to the question of its real importance. Here we may look with advantage to other towns using water of this character. We will cite Cincinnati: At the time these pumping works were constructed, the main part of the city lay along the banks of the Ohio, below them. At the present time, its growth has extended far above, and in rear of them, discharging a large portion of its sewerage into the Miama and Ohio rivers, above the works; the water as now taken by the works not being as good as that in the Mississippi at the foot of Union street.

Notwithstanding this serious fault, the citizens use the water as it is, or provide themselves with private filters; the public sentiment not being as yet convinced that the importance of securing a better quality of water is great enough to justify the expense of going some ten miles up the Ohio for it and providing subsiding reservoirs and mains very much on the same plan as was recommended here, to bring the waters of the Wolf river from above the town of Raleigh: though Cincinnati is very much better able to do that than Memphis would be to incur the expense of the Raleigh reservoirs and conduit.

The water of Wolf river, again, we are told, for some months in each year, by the overflow of the intervening land, becomes mixed with the waters of the Mississippi. This amounts to the same as if for that period of time your citizens were using the waters of the Mississippi. During this time, however, the water passes through a filtering bed, prepared for the purpose, on the bank of Wolf river, which will remove much of its sediment. though it will not probably make much change in its color. But your citizens have been too long accustomed to the Mississippi to need telling that its waters, when taken as they are here, above any source of contamination, and with such care in their admission to the mains, are fit for use for any purpose desired. But a more important point to be considered is the quality of the water during its ordinary flow, and more especially, during the very dry season, a time when both the quality and quantity of water are of more importance than at any other. As to quantity, the Wolf river in its lowest stages furnishes more than sufficient water to supply the city of New York.

Of its qualities, we will first speak of one which has a direct bearing on the industrial interests of your city, and then quote from the report in question.

This quality is its value for use in steam boilers, being in this respect superior to any other water in this section of country. The difficulty of obtaining water suitable for this purpose has been severely felt by parties conducting industrial enterprises here, not only in the difficulty of obtaining water, but in the trouble and expense attending its use; much of that which has been used being not only hard to obtain, but amounting in its action on boilers to a source of positive danger. The removal of this bar to the use of steam in your city cannot but have a great influence on its industrial prosperity.

At the time the report in question was made, the public were generally unaware of the character of the Wolf river; its value for use in steam boilers had been learned by parties whose localities had brought it to their use, but before it reaches the Mississippi, being joined by the Bayou Gayoso, bearing a large portion of the sewerage of the city, and further, the slaughter houses of the city (which are now removed) being located on its banks, its own character was lost to the public from the influence of these causes, standing directly in view between the city and the real character of the river itself.

To determine the question of the qualities of the various sources of supply proposed, the Commission placed in the hands of Prof. J. M. Locke, of Dayton, Ohio, ten specimens of water taken from the Mississippi, the Loosa Hatchie, the Wolf, and from wells in the city. From his able and lengthy report on the subject, we quote the following:

REMARKS ON THE SPECIMENS ANALYZED.

"As the various specimens previous to analysis were known to and distinguished by us by the numbers attached to each package, we have so designated them in the various tables.

"No. 1.—This specimen of water contained a large amount of yellowish brown colored sediment, the greater part of which readily separated from the liquid by settling, but left the water of a yellowish tinge, even after

standing a long time. After filtration, the water remained opalescent, and of a yellowish green cast: the entire amount of sediment contained in one gallon, 20.311 grains.

"No. 2.—This water contains a yellowish sediment, amounting in a gallon to 3.558 grains. After filtration it remains slightly opalescent.

"No. 3.—This water contains a gray sediment, a portion of which was very light and flocculent, but readily separated by filtration: the water remained of a yellowish tinge, but perfectly clear. The sediment from this water was largely composed of alumina, (clay,) and the weight from one gallon, 101.613 grains.

"No. 4.—This specimen was clear, with a dark brown sediment, which was very flocculent, filtered freely, the filtrate being clear, but of a decided yellowish tinge. The sediment was small in quantity, there being in a gallon but 1.260 grains.

"No. 5.—Upon opening the package containing this specimen, there was a decided odor of vegetable matter, which passed off in a short time. The water itself, however, was entirely free from all woody taste. When filtered it was very clear, and of a bluish tinge: the weight of sediment from one gallon, 0.736 grains.

"No. 6.—This specimen, on evaporation, yielded a residium of a light brown color, readily darkening by a slight alteration of temperature. The amount of sediment contained in one gallon, 2.832 grains.

"No. 7.—On opening the bottle containing this specimen, there was a strong odor of sulphretted hydrogen, but after a short time all appearance of the presence of this substance disappeared. The water was very clear, containing but a small amount of sediment, there being but 0.123 grains to the gallon. After removing the sediment the water has a decided yellowish tinge.

"No. 8.—This specimen contained but enough sediment to render it slightly turbid, and is readily made perfectly clear by passing it through the filter. The amount of sediment to the gallon being equal to 0.388 grains. This specimen, it will be seen by reference to the table, contains a smaller quantity of mineral or foreign matter than any other specimen examined, the amount not being greater and the substances such as will be found constituting the impurities of many rainwater cisterns.

"No. 9.—On opening the bottle containing this specimen, there was a decided smell of woody or vegetable matter. It contained sufficient sediment to render it turbid. The sediment in one gallon, 0.987 grains, was

very minutely divided and easily suspended, giving a whitish gray appearance to the water.

"No. 10.—This specimen was very clear, having a peculiar brilliancy that, to the eye of the inexperienced, would have indicated it as the purest, brightest water of the whole series examined, while in fact it contained the greatest number of mineral substances of all the specimens.

"TABLE No. 3.—After having determined by analysis, the number and quantity, or, "what and how much," of the various ingredients are contained in a given specimen, the analyst has gone as far as he can with *absolute*, *positive* certainty; but as these substances in many cases combine with one another, it becomes a question in what manner are they combined in the natural water? In doing this, though the analyst cannot assert that he is positively correct, yet, guided by the chemical affinities of the various substances, his combinations will most probably be correct. In this table we have presented the substances combined according to the best authorities, and our knowledge obtained during their examinations.

[See next page for Analytical Table.]

"The analyses made demonstrated the fact that the universally prevailing opinion, with reference to the superiority of the Mississippi water over that of the Wolf river, is fallacious; and that instead of the Wolf river being inferior in quality to that of the Mississippi, it is proved not only far superior to it, but equal in purity to any public water supply in the United States."

[Signed] JOSEPH M. LOCKE.

JOHN LOCKE, M. D."

TABLE No. 3,

Showing the quantity in grains of the compound ingredients contained in an American gallon (58.372 grains) of each of the Specimens.

	1	2	3	4	5	6	7	8	9	10	REMARKS.
Chloride of Sodium,			2.5392	2.5725						2.7571	
Chloride Calcium,										0.7246	No. 1, - - Wolf River.
Sulphate of Lime,			Trace,							0.4395	No. 2, - Wolf River.
Sulphate Magnesia,										0.1215	No. 3, - - Miss. River.
Carbonate of Soda,						1.9250			3.7360		No. 4, - Hatchie River.
Carbonate of Lime,	0.4889	0.9192	6.2166	5.4768	0.8933	5.6345	10.1586	0.5204	3.2552		No. 5. - Wolf River.
Carbonate Magnesia,			0.8423	1.0078					0.4111	1.7531	No. 6, - - Miss. River.
Carbonate of Iron,	Trace,	Trace,	Trace.	Trace,	Trace.						No. 7. - Hatchie Lake.
Alumina, (Clay,)	0.6636	1.2828	0.3605	0.3926	0.2821	0.5259	0.3376	0.3784	0.4970	0.2963	No. 8, - - Wolf River.
Silicic Acid, (Flint,)	1.5742	2.1274	1.8724	1.0692	1.1921	0.4630	1.1075	0.7821	0.2889	0.2174	No. 9, - Miss. River.
Organic Matter,			1.8020	1.3933	0.3302	2.3138	2.6064	0.6865	1.3980	1.3084	No. 10, - Well in City.
Loss and Soda Salts,	0.0512	0.0537	0.5354	0.4364		0.0339	0.0104	0.0246	0.0319	0.0529	
Total Solid Matter,	2.7781	4.3832	14.1684	12.3490	2.6978	10.8964	14.2299	2.3922	9.6555	7.6713	

Analyzed by JOHN LOCKE, M. D.

There is much more in this report of interest as regards the question of purity of water supply; enough has been quoted, however, to show that we have a supply of good and wholesome water; and with regard to its color, which at seasons of high water is objectionable, it is shown that the Wolf river, carrying but about one-sixth of the weight of sediment, bulk for bulk, which is carried by the Mississippi, has comparatively little that can be removed by any immediate process on a large scale. At the same time, the experience of other towns has shown that the people are not afraid of this color; the more especially, when they are aware of the causes which produce it.

While the efforts of the city to obtain a water supply had so far been of no avail, private citizens were also studying the question. It was evident that a water supply must be had, although the elaborate works planned by the engineers, whose report has been cited, were beyond the ability of the city to construct, nor could a private corporation hope to realize adequate returns from so large an outlay, if able to make it for this purpose. An examination of the water works machinery constructed by the Holly Manufacturing Company, of Lockport, New York, and familiarly known as the "Holly system of water works," as made in different cities where their works were in operation, satisfied the inquirers that works could be constructed here on that plan, the cost of which would be within bounds, from which adequate returns might be reasonably expected.

Having become satisfied on this point, a charter was procured from the General Assembly of the State of Tennessee, constituting certain citizens of Memphis, with others who might associate with them, a body corporate, under the title of the Memphis Water Company, which by that title are to have succession for ninety-nine years, with the exclusive right to supply the city with water, by means of public works, for thirty years, and with the usual powers and liabilities of such organizations. The charter, judgment, contract and mortgage executed by the Company having been issued by it in pamphlet form, it is unnecessary to allude to them here.

The names of the officers and of the persons called in to aid in

the construction of the works, together with the names of the Board of Directors, appear on the second page of this report.

CONSTRUCTION OF THE WORKS.

The construction of a set of water works may be considered complete when the construction of the city in which they are built has ceased.

It is gratifying to be able to make at this time, however, a report showing them in operation, and except in the matter of the tests of pressure, to which the main pipes are being subjected, already able to commence the service to which they are dedicated. Had it not been for a misunderstanding regarding a portion of the pipe in the building and great iron well, by which the order for its manufacture was delayed, and subsequent delays in freights, these tests would have been completed before this time and we should have had the pleasure in this report of showing the works in full and steady operation, as they will be within a few days, it being less than nine months since ground was broken for the enterprise.

The first definite movement towards the construction of the works, was the making of a contract with the Holly Manufacturing Company for a set of their pumping machinery, adapted to the requirements of the situation.

The guaranties of this contract on the part of the Holly Manufacturing Company, was that their work should be of a first-class character in all respects and should have the capacity to raise and distribute for domestic use, three millions of gallons of water in twenty-four hours, and should have a further ability to throw at one time, directly from fire hydrants, on the main lines of pipe in the city, twelve one-inch streams of water to a vertical height of one hundred feet.

The guaranties of this Company being known to be reliable, the studies and arrangements for the pipe system and other portions of the works were carried on with reference to them.

A. R. Ketcham, Superintendent of the Buffalo (New York) Water Works, was employed as Consulting Engineer, and in consultation with the officers of the Company and with the Holly Company, made such general arrangements regarding the site for the works and bills for pipe and other material as enabled the Company to

make a contract for pipe, which was closed on the 6th of April, 1872, with the Gaylord Iron and Pipe Company, of Cincinnati, Ohio, for two thousand tons of cast iron pipe, of such sizes as required, and such special castings as were needed for the same, all this pipe and special castings being guaranteed to sustain a hydrostatic pressure of three hundred pounds per square inch.

On the 11th of May, a contract was entered into with Messrs. Rutherford and Air, of Cincinnati, to dig and refill the trenches for the water pipes, the same parties having the work of laying the pipe in the trenches.

The duties of Mr. Ketcham not permitting his attention to the details of the work to be done, I was employed as Constructing Engineer, and entered upon my duties on the 10th of June, 1872.

On my arrival, I found that no surveys or levels of the grounds selected for the pumping works had been made, and that in general terms, it might be said that all parts of the work had to be started at once, not even having time to familiarize myself with the geography and topography of the city before the work must be started.

In this connection, I should do injustice not only to the person, but to my own feelings, did I not allude to the means which enabled me in so short a time to get the various departments of the work into full and active operation, and without clashing in their details.

Your President, the Hon. John Cubbins, bringing his practical knowledge of almost every mechanical industry in the city, acquired by long business relations with them, to bear on the construction of the works, has given his whole time to the enterprise, even to the detriment of his own business, much of the time spending the whole working day in active supervision of the various gangs of workmen employed, not only enabling myself to make the necessary surveys and plans of construction without delay, but also by his practical knowledge of mechanical work and untiring care and energy, forwarding the work both as regards time and economy of construction as few could have done.

The contractors for trenching and pipe laying having commenced their work, Mr. M. G. Riley was employed to superintend the distribution of pipe, attend to their location and keep record of everything connected with this department, which he has done fully and

satisfactorily. The laying of mains being nearly completed, he has lately taken charge of the tapping of the pipe, in addition to his other duties.

The work at the pumping station being the greater part of that done by the Company, aside from that performed by contract, and having, from the peculiarity of construction, some points of interest, will be described more in detail, reference being had to the plan and elevation accompanying.

LOCATION.

The site of the works is upon the banks of Wolf river, about two miles north of Court Square, and comprises about four acres of land, located on the bluff, on its east bank. At this point, the banks rise directly from the river to a height of thirty-six feet above high water mark, and are so steep that considerable labor was necessary to provide approaches and working room for the connection of the suction main with the filter well, trench, and gravel crib, through which the water is taken from the river.

The grounds occupied by the Company were, at the time of their taking possession, occupied by sheds and buildings, necessitating their removal before the work of construction could go on.

The Paducah and Memphis Railroad was being located at the same time, and as the height of ground through which it must pass in this vicinity necessitated deep cutting, which would be very troublesome not only to the Company, but to the public, if located anywhere east of their works, it was determined to permit the road to pass between the building and Wolf river, the Railroad Company removing the bank between their track and the river to a level with their grade, and thus making room for a side track by which the Company can receive coal or other freight upon their own grounds, an advantage believed to be equal in value to that of the grounds surrendered to the railroad.

The works will be best described in detail, commencing at the source of supply, and following the course of the water to its distribution in the mains.

THE PILING.

The steepness of the river bank made it necessary in order to protect the outside well, and the river end of the tunnel, to drive

rows of sheet piles as retainers to the bank, etc.; two rows were driven at a distance of eight feet between the rows, and four feet apart in the rows, extending in front of the well and grounds for a distance of one hundred and fifty feet along the margin of low water. These piles are of oak, twelve to fourteen inches in diameter, and thirty feet long; driven eighteen feet into the ground, which was previously graded nearly to low water mark, and standing above ground, twelve feet above low water mark.

Longitudinal timbers are bolted to the sides of these at the top, and between these, five-inch oak plank are driven, thus forming two continuous walls of sheet piling; at the ends of these rows, additional piles are driven, and the protecting sheeting extended into the river bank.

THE OUTER WELL.

The sheet piling being driven, the ground between it and the end of the tunnel was graded as low as practicable, this work being in the stratum of sand and gravel which underlies the clay of which the bank is composed. A circle formed of six thicknesses of heavy plank, strongly fastened, was laid upon this foundation, forming a shoe for the brick work of the well. This is eighteen feet in diameter inside; the walls twenty-one inches thick, of hard burned brick, laid in cement in the courses, but with the ends generally left abutting for the purpose of permitting infiltration.

The wall has a batter of half inch per foot on the outside, and correspondingly contracted inside; at heights of five feet, heavy cross timbers and circles of plank are built into the walls for the purpose of giving additional strength, and forming a rest for the end of the suction pipe.

The well having been built to a height of sixteen feet, and the various courses of plank and timber strongly bound with heavy vertical tie bolts, which were placed in position before the brick were laid, the sinking was commenced by excavating the interior and allowing the curb to settle by its own weight.

This was easily and successfully accomplished, but on lowering the curb as far as its height permitted, it was found to be on insecure bottom, making it necessary, as was ascertained by boring,

to sink it seven feet further, where we found a bed of hard sand and gravel.

The additional sinking was a work of great difficulty, from the peculiar character of the stratum through which it had to pass; the sand was so charged with a white clay as to have the consistency of very tough mortar, very difficult to remove, and still flowing under the walls of the well.

This compelled the handling of much more material, and partially undermined the surrounding earth. The greatly increased pressure incident to the increased depth of the well also necessitated strengthening its walls by adding to their thickness on the inside, after we had reached the solid bottom. This well, carrying sixteen feet of water at low water mark, forms the receptacle for the water from the filtering trench, with which it is connected by a gate, giving ample space for the subsidence of any particles of sand or other gritty matter which might find its way into it from any source, thus guarding the pumps from the wear they might be subject to, were not this provision made to secure a body of still water for the reception of the suction pipe. The well is covered with heavy timber, laid close together, these planked over, and the whole covered with sand and gravel.

THE FILTERING TRENCH

Is made by excavating the earth between the two rows of piles to a depth of five feet below low water mark, covering the bottom with three inch oak plank, building on these, side walls of brick, four feet deep, and leaving between them a space of three feet, six inches, thus forming a trench of these dimensions with pervious sides; the top is covered with two thicknesses of three inch oak, with thin stuff between and breaking joints, so as to leave this also pervious to water. The whole is covered in with sand and gravel to a depth of four to six feet, forming a filter when the water in the river rises above low water mark. In extreme low water, when the side surface of this filter only would be subject to the approach of water, it is not expected to be of sufficient capacity to meet the full requirements of the service, but can be extended or other similar arrangements made during the next period of low water.

At times of low water, to insure a full supply, at which times

also the water of Wolf river becomes quite clear, there has been constructed the

GRAVEL CRIB.

This crib is extended from the outer row of piling to the deepest part of Wolf river, and extends about sixty feet in the direction of the stream. It is built first with a bed of heavy oak timber, planked over as a base; on this compartments are constructed, forming on the outer side receptacles for washed gravel, and inside of this a channel to conduct the water to the outer branch of the suction pipe; this insures a full supply of water at its lowest stages, and being carried through three feet of washed gravel, will keep all substances mechanically held in suspension away from the suction; this crib is also securely covered in, and with the filtering trench, insures a full and reliable supply of water.

THE TUNNEL

Extends from the face of the bank within a few feet of the outside well to the bottom of the pumping well, a distance of one hundred and thirty feet; its bottom is twelve feet above low water mark and sixty feet below the surface of the ground occupied by the engine house.

This tunnel was made for the reception of the suction pipe, which extends through it from the outer well and gravel crib to the pumping well. It is five feet high and three and a half feet wide, lined with two courses of hard burned brick laid in cement.

The line of the tunnel being determined by transit, the opposite bank of the river furnished a convenient point to place a stake from which, by placing a plumb line at the mouth of the tunnel, its alignment was kept correctly and easily without the use of instruments. The distance being short, and no engineering difficulties presenting themselves, its construction was rapidly and cheaply accomplished.

THE SUCTION PIPE

Is twenty inches in interior diameter; branching with a Y at the mouth of the tunnel, one part drops into the outer well and the other passes over the well into the gravel crib, care being taken to have no abrupt curve in the pipe to impede the flow of water through it.

Each branch of this pipe is furnished with a stop valve, the location of which was such as to render it necessary to make the valves with special reference to it, as it was deemed necessary to extend the shafts by which they were closed or opened to a point above the tunnel so that they could be operated in high water, when they were themselves submerged.

Passing through the tunnel, the suction pipe enters the iron pump well, where it joins the branch pipe connecting it with the pumps. Where it passes through the side of the iron pump well, the water-tight joint is made by a ring of cast iron, fitted and bolted to the side of the well, and the joint between it and the pipe filled with lead and caulked in the usual manner of making a lead pipe joint.

THE PUMP WELL

Is a tube of boiler iron, eighteen feet in diameter, and sixty feet long, sunk vertically to its whole depth below the floor of the engine building, and forming a receptacle for the gang of eight lifting and force pumps, which by this means are placed within easy reach by suction, of extreme low water, while they are at the same time kept accessible in high water by the well tube being made water tight. The building and placing in position of this tube is a work of some engineering interest, although profiting by the experience of other similar works, and having exceptionally good ground to work in, relieved us of much of the trouble and delay that have been suffered by the builders of other wells of a like character.

The soil of the bluff at the works is a strong retentive clay, containing some sand, but not enough to prevent its making good puddle; and when not saturated with water, will stand to a considerable height in vertical banks. A heavy double truss of twenty-six feet span was built on supporting posts resting on heavy bed timbers, the truss spanning the well at a height from the ground of some eighteen feet.

This truss was covered with boards forming a temporary roof thirty feet square; afterwards extended on one side as a further protection from the weather, and furnished with temporary gutters to keep the rainfall as clear of the well as possible.

The strength of the truss was for the purpose of handling the

weight of the iron well tube; its first use was for the excavation of the earth of the well, which was lifted in tubs, first by mule and afterwards by steam power.

The well was dug in this manner, with a diameter of twenty-four feet, to a depth of about thirty feet, when the dampness of the ground made the diggers, men of long experience in well digging in this soil, afraid to go further. Knowing that the walls would rapidly harden under the great heat of the summer, no provision was made for strengthening them, but the diameter of the cutting was reduced to fifteen feet and carried down with sloping sides to a further depth of about sixteen feet, when it had become reduced to about ten feet in diameter.

Further progress being deemed unsafe, the digging was stopped, the tunnel mean time being in progress towards it.

On the shelf formed by the reduction in the diameter of the well, a platform was constructed for the commencement of the iron work which had meantime been getting ready at the work shop. The iron for this was rolled and cut to exact dimensions by the Swift Iron and Steel Works, of Cincinnati, which also furnished the angle iron with which the well is ribbed on the inside at the center of each sheet. The sheets are three feet in width, length one-sixth of the circumference of the well; the dimension cutting was so well done as to require no trimming. The iron was all punched and rolled to circle at the shop, two templates being used, alike except as to length, which varied proportionately with the difference in circumference of the outer and inner rings of plates.

So exactly were these made that no trouble occurred during the building of the well tube from the dodging of rivet holes or other similar cause.

The iron work of the well was done by Messrs. Lewis & Co., of this city, the shell by contract, the fitting and fastening of the top and bottom girders by day's labor. Their work was all well done, and they can refer to it with satisfaction as it is also a satisfaction to us to speak of them as faithful and good mechanics.

The bottom of the well is formed of eight rolled wrought iron girders of the I form; they were furnished by Carnegie, Kloman & Co., of Pittsburg, Pa., who also cut them at the ends in exact conformity with the drawings sent them for the purpose: they are

fifteen inches in depth, and five inches breadth of flange; the top girders are a duplicate of the bottom, the whole giving credit to the works furnishing them.

The work was started by placing the first ring of sheets in position, carefully centred and leveled, then two or three courses having been put on and riveted, the bottom girders were placed in position and secured to the sides by heavy plates of angle iron, riveted to both sides of the girders and to the well tube, one girder being left unfastened till the tube was sunk to position, for the purpose of giving access to the work necessary in removing the earth for its descent. While this was being done, the tunnel was carried into the well and a communication made between them which permitted the drainage of the soil of the well to its bottom, and also furnished the means of removing considerable earth from it.

During the same time, the lowering apparatus was being constructed; this consisted of four lifting screws, three inches in diameter and three feet travel of thread; these were placed in the top of the truss, the nuts resting on plates supported by cross timbers, the nuts being turned together by four gangs of men in lowering.

To these screws, rods of inch iron were hung, the rods being put together with welded links so as to be manageable in handling; to the bottoms of the rods, large chains were attached, furnished with grab links for convenience in lengthening as the tube was lowered, the chain passed around two of the girders, the tube being thus supported at the bottom, having the top clear for the additions which were made to its height from day to day, as it was sunk; the boiler work was done during the day time and the sinking of the tube generally at night; the screws were considered safe with a load of ten tons each, that being more weight than could come upon them should one be slacked accidentally.

This was guarded against, however, and as a further precaution, where the lives of several men would have been in instant jeopardy by any failure, four heavy lifting screws were placed in position under the well, and handled simultaneously with the great lowering screws; these were found useful also in checking any uneven settlement of the tube, and relieving the labor of turning the upper screws.

The excavation from the shelf where the construction of the

tube was commenced, was made to clear the sides of the well tube two inches all round; the drainage of the earth into the tunnel had made it so firm that no caving occurred; the tube following the excavation made the workmen safe from any fear in this regard, and the line of the work having been carefully kept as it descended, it was finally placed in exact position on the 19th of September, without accident to the work or men.

The height of the tube when thus placed in position, bringing it above the shelf of earth before spoken of, the bottom was carefully secured against leakage from the sides, and the whole space between it and the surrounding walls of earth poured full of cement, thus bringing the weight of the bank against the well tube by hydrostatic pressure, and effectually securing it in its position.

The iron work being carried up to the surface of the ground, twenty-four heavy cast iron anchors were riveted to the outside of the tube and imbedded in the masonry as it was carried by them. The space of three feet between the iron tube and the sides of the well was now filled in with broken stone in layers, each layer being poured full of concrete before the next was added, all well packed down; this was carried to a depth of eight feet when the brick work was started. On the side next the machinery the whole space was filled with brick, the rest of the circumference of the well; the wall is twenty inches thick, the whole laid in cement; the earth was now filled in and puddled to the top of the ground.

The upper sheets being put on and the top girders set, on the plumb lines being hung for the setting of the pumps, the tube was found to vary but three-eighths of an inch in its whole height.

Being thus secured against settling by its own weight or being lifted by the water, which at some seasons rises to a height twenty-three feet above its bottom, the excavation was continued and a course of heavy cross timbers bedded in brick and cement placed under and around them, and forming a bed of concrete and timber on which a floor of four inch oak was placed, strongly bolted down and the seams heavily caulked with oakum.

A ring of oak plank in short pieces was then driven under the edges of the tube, which had been prepared for their reception by placing angle iron at the bottom to make the joint with the wood so that it could be caulked like the rest, these being thoroughly

fastened and caulked, and the tightening of the bottom of the well thus completed, the girders were blocked by placing under them pieces of oak, extending from girder to girder, at close intervals, thus diffusing the weight of the well tube and machinery over the bottom of the well.

THE ENGINE FOUNDATIONS.

The inner well being thus completed, except the platforms, which were afterwards placed in it for convenience of access to the pumps at the bottom, the foundations of the engines were started on the same level with the foundations of the building, which, during the progress of this work, had been carried nearly to completion. These were built in form corresponding to the requirements of the machinery, of hard burned brick, laid in flemish bond, and thoroughly grouted in every course. The top is covered with Alabama limestone, in large slabs, one foot in thickness, covering the whole space occupied by the machinery. The holding down bolts were bedded in the brick work with large cast iron anchors, and pass up through the cap stone, which was drilled for their reception, and lowered over them into the bed of cement prepared for them. The stone being carefully got out, both in bed and build, makes a fine appearance. The action of the machinery shows that all this work was well and substantially done.

THE BUILDING

Is a plain substantial structure of brick, forty-three by seventy-two feet, with a boiler room on the north side, thirty-seven by forty-three feet, covered with a heavy trussed roof, the timbering of which, as well as the rafter joists and under side of the roof boards, is planed and painted; the covering is of tin.

The walls of the building are pierced with numerous windows, which open at the top and bottom for the purpose of giving free ventilation in hot weather.

The floor is of two inch plank, laid on heavy joists and timbers, and in its turn covered with one and a half inch matched hard pine of the best quality; in the rear of the engines a partition is thrown across, making a room for the engineers, another for the firemen, a store room, and a work room or shop overhead. Under the floor is the net-work of steam and water pipes, together with the

gas pipes, (the building being lighted by a small set of portable gas works,) which are thus out of the way and at the same time easy of access.

The chimney is nine and a half feet square at its base, which size it carries to the height of the cornice of the boiler house, when it changes to an octagon; its whole height is seventy five feet; the flue carried inside separately from the outer part of the chimney is forty-two inches in interior diameter; the whole is capped with a cast iron plate, made in sections and bolted together.

The masonry, with the exception of the tunnel and outside well, which were too far from the building to be conveniently cared for by the same person, was under the direction of Mr. Thomas Cubbins.

The extreme hot weather in July and August made the work intermittent, and at times stopped it altogether; the masons also suffered seriously from the constant noise kept up by the gangs of riveters in the well, but as this could not be helped, they bore it good humoredly, and great care being taken to guard against the effects of the hot weather, not a single case of sunstroke occurred at the works, though during the time the papers recorded at one time as high as fifteen cases in the city, among pipe layers, in a single day.

The work of the building, with the exception of a portion of the excavation for foundations, was, with the work on the river bank, tunnel and wells, and a considerable part of the work on the reservoir, done by day's labor, the intermingling of so many branches of work, and the necessity of changing the men frequently from one part of the work to another, making any contract work in this case almost impracticable.

The whole being done directly under Mr. John Cubbins' and my own constant personal supervision, and his practical acquaintance with the work and knowledge of the men enabling him to procure and keep an exceptionally good working force, I judge that the work was fully as cheaply done as it could have been by contract and more thoroughly and satisfactorily.

WATER SUPPLY SYSTEMS.

The importance of water works and the great engineering skill

which has been brought to bear on the construction of the different forms of machinery which have been devised for the purpose of elevating water, where it was necessary to move it by mechanical appliances for the supply of communities, have naturally made each builder of such machinery sure that his was the best, and anxious to convince the public of the fact. Accordingly, we have pamphlets by the score, generally prefaced with a well written treatise on the importance of a good and adequate supply of water and very generally containing valuable information on the subject; but as we read with growing interest, we gradually become aware that while we are doing so, the writer is carefully grinding his own particular axe. Now his particular axe is the one we want, if our case suits the capabilities of his work better than any other; but if not, we want something else, and we will not find it in his work. Neither are engineers always free from prejudice. Many of them having become acquainted with some particular way of obtaining results, are averse to change and slow to admit the superiority of some other system.

Accordingly, I have thought it not amiss in describing the machinery of these works to speak briefly of other systems, having no axe to grind in the matter, and being equally willing to do justice to all, though I may not be equally able.

Justice to other communities who may look to such pamphlets as this for information would seem to point to this course on the part of engineers, and it can certainly do no harm.

The present practice of water works may be classed under three heads:

THE RESERVOIR SYSTEM.

THE STAND PIPE SYSTEM.

THE "HOLLY," OR DIRECT PRESSURE SYSTEM.

The last being the newest, and from its own merits and the energy of the Company, who have the "*modus operandi*" of it well secured by letters patent, being more frequently introduced at present than both the others.

This Company also understand the grinding of their own particular axe, and the fact that the "most successful thing in the world is success," while it brings them an immense amount of work, brings of course a corresponding amount of opposition from other

builders and others acquainted with and prejudiced in favor of the older systems.

The most important part of a system of water works is the getting of an adequate supply of good water. In some cases this is easy, in others a matter of extreme difficulty; in either case its importance far outweighs the particular "system" which may be used in conjunction with it.

The next in importance as being generally the greatest item in cost is the pipe system; this cannot be too carefully studied, and a town putting in water works and failing to have this well and carefully done, make a grave mistake, in dollars, at least.

Last, but by no means of minor importance, is the machinery to be used.

The reservoir system is based on elevating the water to some point from which it can be distributed by the power of gravity; it has strong points, especially as regards economy of fuel; the steady and uniform duty required of the engines for filling these reservoirs enables the highest engineering economy to be gained in the consumption of fuel, while if the engines are sufficiently large they can be run in the daytime only, thus employing but a single set of attendants. This last advantage is generally soon lost, however, by the growth of the water supply demanded.

The objections to it are, that it is generally the most costly of the systems, and that it cannot but in exceptional cases be used for the suppression of fires without the aid of fire engines, having no power but that of gravity to increase the flow of water in the pipes, the acceleration of which is rapidly destroyed by friction.

The great height at which it would be necessary to place a reservoir to meet these conditions, which under late engineering precedents have taken so strong a hold on the esteem of the public, may be seen by the fact that the pressure used for throwing fire streams is generally equivalent to a head of two hundred feet and frequently to a height of three hundred feet where the water is being forced rapidly through long lines of pipe.

In the Holly system this is done as easily as a set of scales are moved to weigh a greater weight.

In the reservoir system no accession of pressure can be given; on the contrary, the pressure is least when it is most needed.

The pumping of water to a height of two hundred feet, it will be easily understood, takes twice the power that it does to elevate it one hundred feet; the first height being taken to represent fire pressure and the last to represent a pressure sufficient for ordinary domestic purposes; as the added pressure is wanted for so small a portion of the time, it may be practically disregarded as far as concerns the use of fuel. The reservoir system, to give the required results, would have to be *all* pumped to the greater height, and as no superiority of steam use could be reasonably expected to raise the water two hundred feet easier than the Holly or other similar system could raise it one hundred feet, the economy would clearly seem to be on the side of the works having the power at will to apply any desired pressure to the water in the mains.

The stand pipe system is based, like the reservoir system, on the force obtained by gravity; instead of a reservoir, a vertical pipe is set up near the works, its height being sufficient for the purposes desired of it, and thus fulfilling in a measure the functions of a reservoir. Not having capacity, however, to store water for more than momentary supply, the system, like the Holly system, of which it was the precursor, is based on continuous pumping; like the Holly system also, it is adapted to places having no suitable elevation on which to build a reservoir, and like it, though not to so great an extent, has the ability to increase the pressure of water in the mains.

Both these systems are open to the grave objection that when the machinery stops the supply stops. Modern engineering, however, says that the machinery must not stop, and builds it accordingly; and so far as human foresight can present, and the experience of more than fifty places show that this is a good way, the contingencies seem to be well guarded against, and both these systems, as well as the reservoir system, have their earnest and disinterested advocates.

More space cannot be spared here for a comparison of the different systems. This city having no elevation on which to place a reservoir, the choice was narrowed to that between the stand pipe and Holly systems.

The ability to throw fire streams directly from the hydrants having been proved to exist, and being of itself one of the most

valuable sources of revenue to be derived from the works, and of still greater value to the community, must be had. The choice here was given to the Holly system.

Had it been given to the stand pipe system, the stand pipe, to give the pressure to which the pipes have been subjected by the Holly tests, would have required a height of three hundred and fifty feet, and for ordinary use in fire service, about two hundred and fifty feet, a difficult and expensive tube to set on end.

THE MACHINERY

Erected here by the Holly Co., to fulfill the guarantees given by them to this Company, in their contract with it, consists, first, of eight lifting and force pumps, each of twenty inches diameter and twenty-four inches stroke. These are placed in the bottom of the well, resting upon a heavy frame work, through a portion of which water is carried to them from the suction pipe, each pair of pumps being furnished with a separate stop valve so that any number desired can be run at once, or any pump removed if desired for repairs while the rest are in action.

The water from these passes to the rising main, which stands in the center of the well; rising through this it passes directly into the twenty inch main extending to the city.

The lifting power is communicated to these pumps by long rods extending to the top of the well, where they enter guiding cylinders answering the same purpose as the cross head guides of an engine, and in which they join the crank connecting rods in the same manner as the connecting rod of an engine is attached to its cross head.

On the top of the well stands a massive frame-work of iron, sustaining four large gears which are driven by pinions on two shafts which extend to this frame from the main engine, and are furnished with clutch couplings for convenience of using part of the machinery or the whole as may be desired.

Each of these large gear shafts has a crank on each end, each gear thus driving two pumps; an additional crank on the upper driving shaft carries the air pump, which, being a device common to all low pressure engines, and not affecting the results to be attained by the machinery, otherwise than as regards economy of fuel, is passed by without description, other than that it is proper

to say its arrangements are such as to enable the engineer to change the action of the engines from low to high pressure, or the reverse, at will, and at a moment's notice.

The main engines are two cylinders of twenty-one inches diameter by thirty-three inches stroke, working at right angles to each other, both acting upon the same crank, the main shaft being placed upon the top of the massive iron frame to which they are attached; the engines standing at an angle of forty-five degrees with the horizon at the bottom and outside of the frame. On the main shaft is the balance wheel, and a large gear transmitting motion to an intermediate gear below it; this carries the second shaft connected with the gang pump and performs the further office of driving the rotary pumps when desired, arrangements similar to those spoken of with reference to the gang shafts, permitting ready shifting in these also.

The rotary pumps, two in number, are constructed with water tight cases in which revolve cam, or rather gear, wheels of peculiar form, carefully ground together, and so arranged that the revolution of the pump forces a continual flow of water through it, the size of pump used here giving sixteen gallons of water to each revolution, (thirty-two gallons for both.)

When it is borne in mind that these pumps are so strong as to be able, without injury to themselves, to carry a pressure of two hundred pounds to the square inch, and like the engines which drive them, are capable of running at locomotive speed, the great quantity of water they are able to supply will be the better appreciated.

For convenience in the use of these pumps, which are specially designed for the fire or high pressure service, a reservoir has been built near the works; this will be described hereafter.

The great power necessary to force water through the mains for fire service, made it advisable not to use the gang pumps for this purpose, though they are capable of fair service in this respect.

The use of the reservoir permitting the storage of a large quantity of water at an elevation of some seventy-five feet above low water mark, enables the engineer when a fire alarm is sounded, to stop the gang and set the rotary pumps at work, taking water from the reservoir, already raised to the top of the bluff, though the

gang may be kept at work, if desired, during the time, in this case the rotary pumps taking the water from the gang and returning it to the mains with increased pressure.

To enable this combined action of the pumps to be made, an auxiliary engine is provided, similar in its action to that of the pumps—a small machine, but one of great power. Generally, however, the use of this is unnecessary; the ease with which the power of the main engines is transferred from the gang to the rotary pumps making it of more real value as a safeguard against the stoppage of the water supply, when from necessity or convenience the main engines may be stopped.

The method of maintaing a uniform pressure on the mains, notwithstanding the constantly fluctuating demand made by the supply required, must be described, as this is the distinctive characteristic of this system.

The engines are provided with variable cut-offs capable of changing the admission of steam to the cylinders from about one-eighth to about seven-eighths of the stroke, thus changing their power and speed from moment to moment, as the pressure in the mains requires. These cut-offs are governed by a somewhat complicated apparatus which is in its turn governed by the pressure of water in the mains, any change in this pressure being transmitted to this governor and from this to the engine. Its action is double, one part giving a gradual motion to the shifting of the position of the cams, the motion of which governs the point of cutting off steam, while the other part stands sentry against unusal fluctuations in pressure.

The reason for this complication, which is the result of practical experience, would unnecessarily lengthen this article, already too long, and be of little interest to the general reader.

In connection with this may be noticed the alarm whistle, which notifies the engineer, with a voice not to be mistaken, when his pressure is too low, and also gives instant notice when hydrants are opened to give the alarm of fire; the effect of such opening being to suddenly lower the pressure of water in the mains, a very few seconds elapse before the shrill voice of the whistle notifies the engineer of the fact.

An auxiliary feed water engine is also provided, and a heater:

these need not be described, and, pausing only to notice the water safety valve, which, though apparently complicated, is only a safety valve after all, having no other office than to guard the mains against accident from undue pressure, we pass into the boiler room. Here are three boilers, sixteen feet in length, by five feet in diameter, with eighty-three three-inch flues in each; beside this battery of boilers stands an upright boiler made with special reference to quick steaming, being able to give steam in ten minutes from the lighting of the fires, and to furnish one hundred horse power of it.

This is not generally in use, its office being to add to the steam supply in cases of sudden call, faster than could be done by the other boilers which are not in use, (only one of the four boilers being required for present use.)

COAL STORAGE.

At the end of the boiler house is the coal shed, (not yet completed;) its present dimensions are forty by sixty feet, from which, following the course of a natural gully in the bank at this point, an inclined tram road descends to the sheet piling on the river bank: on this is placed a coal car or skip similar to those used in mines for a like purpose, thus enabling the works to procure coal directly from the barge in the river, easily and cheaply, so far, at least, as regards handling.

THE RESERVOIR

Before spoken of, is a parallelogram with rounded corners, its location, form and vertical section being given in the plan accompanying this. It has a capacity of 3,098,040 gallons. The excavation of this reservoir was done by contract, the puddling and paving of its banks by day's labor, so far as it is done. It is not completed, but other work pressing, and the reservoir being capable of all the storage desired at present, the finishing of it has been deferred till a more convenient time. Its office having been previously spoken of, no further description of it is here necessary.

MEMPHIS, APRIL 10TH, 1873.

At the time this report was due, and at which the previous part is dated, I was very busily engaged in the tests of the pipe and machinery then progressing, for which reason your Board

deferred the hearing of this report till the present time, to enable me by that means to make it more complete as regarded the action of the machinery and the completion of the tests to which the pipe were being subjected; the delay will have a corresponding influence on the report of the Secretary, which can by the same means be brought up to the first of this month.

On the 24th of March, the main lines of pipe in the city having been tested to a sufficient pressure, and some trial streams having been previously thrown, four streams were tried with nozzles of from one and a quarter to one and five-eighths inches in diameter; the largest stream was measured by transit and found to rise one hundred and seventy feet; horizontal distance two hundred and twenty feet; water pressure at the works one hundred and twenty-five pounds to the square inch. This test being satisfactory, it was determined to make the test for twelve one inch streams, one hundred feet high, on Saturday, March 29th.

The trial commenced at four o'clock, P. M., and continued two hours; twelve streams were thrown from various points, mostly on the smaller and most distant outlying lines of pipe, the ability of the works to throw streams at these points being considered much more questionable than in the more central part of the city.

The twelve streams were put on within as many minutes or less; one or two were afterwards shifted to different hydrants, and towards the last of the trial thirteen streams were on at the same time.

Four of these streams, purposely selected as being likely to be the lowest, from their distance from the main lines of supply, were measured by transit, by the City Engineer, the results giving from one hundred and thirteen to one hundred and twenty seven feet vertical, and from one hundred and fifty-three to one hundred and eighty feet horizontal throwing.

Other streams on the main lines were evidently higher, their average horizontal measurement being about one hundred and eighty feet; the longest one measured two hundred and one feet, eight inches.

This test, though more than fulfilling the requirements, was less satisfactory than that made by engineers selected for the purpose by his Honor, Mayor Johnson, this test was of the action of

the machinery during the throwing of the streams, giving a good criterion to judge the real capacity of the works by, the streams thrown being but a part of it.

REPORT.

TIME.	STEAM PRESSURE.	WATER PRESSURE.	REVOLUTIONS.
4:00 P. M.	70 lbs.	120 lbs.	60
4:20 "	70 "	110 "	70
4:40 "	70 "	115 "	60
5:00 "	70 "	115 "	65
5:20 "	65 "	115 "	65
5:40 "	65 "	115 "	70
6:00 "	65 "	115 "	60

"This table, abridged from the report of James Clark, engineer of Steamer No. 2, shows the gratifying fact that during the test the engines were not run to more than half the speed they were capable of, and the firing of the boilers was correspondingly light, the smooth, easy action of the machinery, and the perfect solidity of the foundations, also adding to the certainty that the power of the engines is sufficient to throw double the number of streams thrown at this test."

An error appeared in the corresponding report of the amount of water thrown during the test, arising from a mistake in recording the water level in the reservoir at the beginning and end of the test—it is here corrected:

Whole amount thrown, - - - -	319,862 gallons.
Amount to each stream, - - - -	26,665 "
Rate per minute to each stream, - - -	222 "

By previous measurements of the pumps, and by tests of their pumping into the reservoir, I had become satisfied that they were able to supply 5,000,000 gallons of water in twenty-four hours, and also that they were able to throw twenty fire streams at one time.

The tests showing the same fact, and that the Holly Company had, as they usually have done, given a good working margin on

the power of their machinery, and further guaranteeing it against accident from any weakness arising from improper proportions, bad material, or workmanship, their contract was acknowledged fully, and satisfactorily filled.

The pipe laying by Messrs. Rutherford and Air, in fulfillment of their contract with the Company, is completed, with the exception of some short lines recently ordered in addition to the previous lines, the pipe for which has not yet arrived. The work has generally been done with very little annoyance to the citizens, and the streets, with the exception of a few depressed places which the contractors are now engaged in perfecting, are in perfect order.

In applying the pressure tests, several pipes gave way, showing, however, in every case old cracks, which it was presumed had been caused by rough handling in transportation, and escaped observation in the hammer tests to which the pipe were subjected before being laid in the trenches. These were promptly repaired by the contractors without cost to this Company. The pressure has been carried to one hundred and sixty pounds to the square inch, giving a large margin for safety over any future requirements in this direction.

DISTRIBUTION OF PIPE.

20 INCH.

	FEET.
Suction from river to well	220
From Building to Second street	799
From Lane to Saffarrans, on Second street	3,214
	4,233

16 INCH PIPE.

From Building to Reservoir	175
On Second street, from Saffarrans to Jackson	2,628
	2,803

12 INCH PIPE.

On Jackson street, from Second to Third alleys	417

10 INCH PIPE.

At Water Works	30
On Jackson street, from Third to Fourth alleys	380
On Fourth alley, from Jackson to Union streets	4,171
On Second alley, from Jackson to Union streets	4,180
	8,761

8 INCH PIPE.

At Water Works	6
On Keel street, from Second to Fifth	1,160

	FEET.
On Fifth street, from Keel to Auction	2,225
On Auction street, from Fifth to Third	750
On Third street, from Auction to Jackson	1,110
On Auction street, from Second to Chickasaw	770
On First alley, from Jackson to Union streets	4,181
On Chickasaw street, from Auction to Bayou	1,050
On First alley, from Jackson to Auction streets	1,130
On Jackson street, from Second alley to First alley	404
On Washington street, from First alley to Fourth alley	1,193
On Shelby street, from Union to Vance	2,380
On Union street, from Shelby to DeSoto	1,820
	18,179

6 INCH PIPE.

At Water Works	180
On Third alley, from Jackson to Union streets	4,178
On Market street, from Fourth alley east	651
On Poplar street, from Fourth alley to Orleans street	3,350
On Adams street, from Fourth alley to Orleans street	3,500
On Madison street, from Fourth alley east	1,780
On Union street, from DeSoto to Lauderdale	1,950
On DeSoto street, from Union to Beale	984
On Vance street, from Shelby to Orleans	5,640
On Shelby street, from Vance to Butler	1,370
On Second street, from Union to Beale	1,118
On Main street, from Vance to Huling	683
On Beale street, from Second to Lauderdale	3,514
On Lauderdale street, from Beal to Linden	758
	29,636

5 INCH PIPE

On Orleans street, from Poplar to Union	2,700
On Union street, from Orleans to Lauderdale	1,130
On DeSoto street, from Beale to Vance	1,508
On Linden street, from Lauderdale to Cynthia	420
On Cynthia street, from Linden to Vance	730
	6,488

4 INCH PIPE.

On Concord street, from Front to Main	322
On Overton street, from Front to Main	322
On Jackson street, from First alley west	385
On Market street, from First alley west	475
On Carroll Avenue	920
On Exchange street, from Fourth alley east	653
On Poplar street, from first alley west	541
On Washington street, from Fourth alley east	1,060
On alley between Adams and Jefferson streets, from First alley west,	500
On Jefferson street, from Fourth alley east	713
On Court street, from Fourth alley east	713
On Monroe street, from Fourth alley east	385
On East Jefferson street, from Orleans street west	500
On East Court street, from Orleans street east	513
On Union street, from Shelby street west	300
On Gayoso street, from Shelby street west	300
On Beale street, from Shelby street west	300
On Jessamine street, from Lauderdale street east	200

	FEET.
On Talbot street, from Shelby street west	456
On Huling street, from Shelby street west	457
On Trezevant street, from Shelby street west	454
On Shelby street, from Butler to Calhoun	645
On Main street, from Huling to Elliott	689
On Tennessee street, from Trezevant to Butler	545
On Vance street, from Orleans street east	500
On Calhoun street, from Shelby street east	200
Laid with 176 hydrants	4,289
	17,337

Whole amount of pipe laid to date, 87,854 feet, a little under 17 miles.

A small amount of pipe is yet on hand, which will probably be laid within a few days, but is not here located.

Some of the above measurements having also been taken from the map, the final measurement will probably change these figures in some cases. The remedy for this will be in the next report, which, if the pipe is extended as required by the urgent demands and wants of the community, will show a considerable addition to the lines already laid.

HYDRANTS

Are located at the following points; all these are double; that is, having two spigots for the direct attachment of hose, enabling two fire streams to be thrown from each:

On Kerr Street—No. 1, south-west corner Second street.

On Keel Street—No. 2, south-east corner Second street; No. 3, North-west corner Fifth street.

On Looney Street—No. 4, north-west corner Fifth street.

On Saffarrans Street—No. 5, south-west corner Second street; No. 6, north-east corner Fifth street.

On Chickasaw Street, (line of Greenlaw,)—No. 7, at bayou; east side of street.

On Greenlaw Street—No. 8, south-east corner Second street; No. 9, south-east corner Fifth street.

On Mill Street—No. 10, south-east corner Chickasaw street; No. 11, north-east corner Second street; No. 12, north-west corner Fifth street.

On Sycamore Street—No. 13, south-east corner Chickasaw street; No. 14, north-west corner Fifth street.

On Auction Street—No. 15, south-east corner Chickasaw street; No. 16, south-west corner Main street; No. 17, south-west corner Second street; No. 18, north-east corner Third street; No. 19, north-west corner Fourth street.

On Concord Street—No. 20, south-east corner Chickasaw street; No. 21, south-west corner Main street; No. 22, south-east corner Second street; No. 23, south-west corner Third street.

On Overton Street—No. 24, south-east corner Chickasaw street; No. 25, south-west corner Main street; No. 26, north-west corner Second street; No. 27, south-west corner Third street.

On Jackson Street—No. 28, north-east corner Promenade street; No. 29, north-east corner First alley; No. 30, south-west corner Second alley; No. 31, south-west corner Third alley; No. 32, south-west corner Fourth alley.

On Winchester Street—No. 33, north-east corner First alley; No. 34, south-west corner Second alley; No. 35, north-west corner Third alley; No. 36, south-west corner Fourth alley.

On Market Street—No. 37, north-west corner Promenade; No. 38, north-east corner First alley; No. 39, north-east corner Second alley; No. 40, north-east corner Third alley; No. 41, south-west corner Fourth alley; No 42, north side, 350 feet east of Fourth alley; No. 43, south-east corner Fourth street.

On Carroll Avenue—No. 44, 450 feet east of Fourth street, north side; No. 45, 900 feet east of Fourth street, north side.

On Exchange Street—No. 46, north-east corner First alley; No. 47, north-east corner Second alley; No. 48, north-east corner Third alley; No. 49, south-east corner Fourth alley; No. 50, north side, 350 feet east of Fourth alley; No. 51, north-east corner Fourth street.

On Poplar Street—No. 52, 540 feet west of First alley; No. 53, south-west corner First alley; No. 54, south-east corner Second alley; No. 55, north-east corner Third alley; No. 56, south-east corner Fourth alley; No. 57, north side, 340 feet east of Fourth alley; No. 58, south-east corner Fourth street; No. 59, north side, 410 feet east of Fourth street; No. 60, south side, 400 feet east, (810 feet from Fourth street;) No. 61, north side, 10 feet east of High street; No. 62, south side, 513 feet east of High street; No. 63, north side, 957 feet east of High street; No. 64, south-east corner Orleans street.

On Washington Street—No. 65, south-west corner First alley; No. 66, north-west cor Second alley; No. 67, south-east corner Third alley; No. 68, south-east corner Fourth alley; No. 69, north side, 340 feet east of Fourth alley; No. 70, south-east corner Fourth street; No. 71, north side, at bayou; No. 71*a*, north-west corner Orleans.

On Adams Street—No. 72, north-west corner First alley; No. 73, north-east corner Second alley; No. 74, south-west corner Third alley; No. 75, north-east corner Fourth alley; No. 76, south side, 386 feet east of Fourth alley; No. 77, north-east corner Fourth street; No. 78, south side, 378 feet east of Fourth street; No. 79, north side, 454 feet east of No. 78; No. 80, south side, 390 feet east of No. 79; No. 81, north side, 230 feet east of High street; No 82, south-west corner of Lauderdale street; No. 83, south side, 371 feet east of Lauderdale street; No. 84, south-west corner Orleans street.

No. 85, *On alley between Adams and Jefferson streets*, 544 feet west of First alley.

On Jefferson Street—No 86, south-east corner First alley; No. 87, south-east corner Second alley; No. 88, south-west corner Third alley; No. 89, south-east corner Fourth alley; No. 90, 340 feet east of Fourth alley; No. 91, north-east corner Fourth street; No. 92, 500 feet west of Orleans street; No. 93 north-west corner Orleans street.

On West Court Street—No. 94, north-east corner First alley.

On North Court Street—No. 95, south-west corner Second alley.

On South Court Street—No. 96, north-west corner Second alley.

On East Court Street—No. 97, south-west corner Third alley; No. 98, south-east corner Fourth alley; No. 99, 340 feet east of Fourth alley; No. 100, corner Fourth street; No. 100*a*, south-east corner Orleans street; No. 101, north-west corner Boundary Avenue.

On Madison Street—No. 102, south-east corner First alley; No. 103, south-east corner Second alley; No. 104, north-east corner Third alley; No. 105, south-east corner Fourth alley; No. 106, south-east corner DeSoto street; No. 107, north side, 430 feet east of DeSoto street; No. 108, north side, 860 feet east of DeSoto street; No. 109, north-east corner Wellington street; No. 110, north-west corner Orleans street.

On Monroe Street—No. 111, south-east corner First alley; No. 112, south-west corner Second alley; No. 113, south-west corner Third alley; No. 114, south-east corner Fourth alley; No. 115, south-east corner DeSoto street; No. 115*a*, north-west corner Marshall Avenue and Orleans street.

On Union Street—No. 116, south-east corner Clinton street; No. 117, south-east corner Shelby street; No. 118, north-west corner Main street; No. 119, south-east corner Second street; No. 120, south side, line of Third street; No. 121, north side, 110 feet east of Fourth alley; No 122, south-east corner DeSoto street; No. 123, south side, 475 feet east of DeSoto street; No. 124, north side, 170 feet west of Wellington street; No. 125, south side, 290 feet east of Wellington street; No. 126, north side, in line of center of Lauderdale street; No. 127, south side, 600 feet east of Lauderdale street; No. 128, north-west corner of line of Orleans street extended.

On Gayoso Street—No. 129, north-east corner Clinton street; No. 130, south-east corner Shelby street; No. 131, south-east corner Second street; No. 132, south-west corner DeSoto street.

On McCall Street—No. 133, north-west corner Shelby street.

On Beale Street—No. 134, at Elevator; No. 135, north-east corner Shelby street; No. 136, south-west corner St. Martin street; No. 137, south side, 350 feet west of Hernando street; No. 138, south-east corner Hernando street; No. 139, north-east corner DeSoto street; No. 140, south-east corner Turley street; No 141, north-west corner Wellington street; No. 142, south-east corner Lauderdale street.

On Jessamine Street—No. 143, south side, 200 feet east of Lauderdale street.

On Linden Street—No. 144, south-east corner Shelby street; No. 145, south-east corner DeSoto street; No. 146, north-east corner Lauderdale street; No. 147, south-east corner Cynthia street.

On Pontotoc Street—No. 148, south-east corner Shelby street.

On Vance Street—No. 149, south-east corner Shelby street; No. 150, south-east corner Main street; No. 151, north-east corner St. Martin; No. 152, south-east corner Causey street; No. 153, north side, opposite Allen's Avenue; No. 154, north-west corner Hernando street; No. 155, south-west corner DeSoto street; No. 156, south-west corner Echols street; No. 157, north-east corner Wellington street; No. 158, south-west corner Lauderdale street; No. 159, north-west corner Cynthia street; No. 160, north-east corner Orleans street; No. 161, south side, 500 feet east of Orleans street.

On Talbot Street—No. 162, south-east corner Tennessee street; No. 163, south-west corner Shelby street; No. 164, north-east corner Main street.

On Huling Street—No. 165, south-east corner Tennessee street; No. 166, south-west corner Shelby street; No. 167, north-east corner Main street.

On Trezevant Street—No. 168, south-east corner Tennessee street; No. 169, north-east corner Shelby street.

On Butler Street—No. 170, north-east corner Tennessee street.

On Shelby Street—No. 171, west side, 150 feet south of Butler street.

On Elliot Street—No. 172, north east corner Main street.

On Calhoun Street—No. 173, south-east corner Shelby street.

LOCATION OF STOP VALVES.

20 INCH.

One geared valve in outer or crib suction; one geared valve in inner or well suction; one Ludlow valve in main eight feet east of building.

18-INCH.

In Second street main, center of Saffarrans street.

16-INCH.

In Second street main, north line Jackson street.

12-INCH.

On Jackson street, west line Third alley.

10-INCH.

At Water Works, between main and Reservoir; on Second alley, south line Jackson street; on Fourth alley, south line Jackson street; on Second alley, north line Washington street; on Second alley, south line Washington street; on Fourth alley, north line Washington street; on Fourth alley, south line Washington street; on Second alley, north line Union street; on Fourth alley, north line Union street.

8-INCH.

Waste for reservoir at works; on Keel street, 11 feet east of Second street main; on Keel street, west line of Fifth street; on Fifth street, north line of Sycamore street; on Third street, north line of Jackson street; on Auction street, west line of Second street; on First alley, south line of Auction street; on Jackson street, west line of Main street; on First alley, north line Jackson street; on First alley, south line Jackson street; on First alley, north line Washington street; on First alley, south line Washington street; on First alley, north line Union street; on Washington street, east line Main street; on Washington street, west line Second street; on Washington street, west line Third street; on Union street, east line Front Row; on Union street, west line Main street; on Union street, west line Second street; on Union street, west line Third street; on Shelby street, north line of Vance street

6-INCH.

At Water Works; with hydrant off Second street main for Bickford Avenue; on Third alley, south line Jackson street; on Third alley, north line Washington street; on Third alley, south line Washington street; on Third alley, north line Union street; on Market street, east line Fourth alley; on Poplar street, east line Fourth alley; on Poplar street, west line Orleans street; on Adams street, east line Fourth alley; on Adams street, west line Lauderdale street; on Madison street, east line Fourth alley; on Union

street, east line DeSoto street; on Union street line for Second street; on Union street line for Main street; on DeSoto street line, south-east corner Union street; on DeSoto street, north line Beale street; on Beale street, west line DeSoto street; on Beale street, east line DeSoto street; on Beal street, West line Lauderdale street; on Shelby street, south line Vance street; on Vance street, east line Hernando street; on Vance street, west line Lauderdale street; on Cynthia street, north line Vance street; on Vance street, east line Shelby street.

5-INCH.

On Orleans street, east side Poplar; on Orleans street, north side Madison; on Union street, center of Lauderdale; on DeSoto street, south side Beale; on DeSoto street, north side Vance.

4-INCH.

With hydrant on Kerr and Second streets; for hydrant on Looney street and Second; with hydrant on Saffarrans street and Second; with hydrant on Greenlaw street and Second; with hydrant on Mill street and Second; with hydrant on Concord street and Second; with hydrant on Overton street and Second; on Market street, west line First alley; on Poplar street, west line First alley; on alley between Jefferson and Adams streets, First alley; on Exchange street, east line Fourth alley; on Washington street, east line Fourth alley; on Jefferson street, east line Fourth alley; on Court street, east line Fourth alley; on Monroe street east line Fourth alley; on Gayoso street, east side Shelby street; on Beale street, west line Shelby street; at Peabody Hotel, east curb First alley.

The remaining facts and figures connected with the construction of the works will be found in the report of the Secretary.

The hydrant service being now in operation and ready for use for the suppression of fires, I would respectfully recommend, if not already done, that your Board request the officers of the city government to pass the necessary ordinances for their protection.

In conclusion, permit me to express my obligations to the members of your Company for the constant and uniform kindness and courtesy which you have extended to me during my stay in your place, and to hope that the works may be as successful as you desire.

Respectfully submitted,

G. W. PEARSONS,
Constructing Engineer.

SECRETARY'S REPORT.

OFFICE MEMPHIS WATER COMPANY,
April 30th, 1873.

To the Honorable President and Board of Directors:—

GENTLEMEN: I herewith submit a detailed report of the disbursements of moneys in the construction of the works to date. Several of the contracts have not as yet been completed, and will show as so much paid on account. I also submit a copy of the water rates, rules and regulations adopted by your honorable Board. There are one or two accounts shown which do not go with the construction of the works: Fuel Account, Small Pipe Account, and Incidental Account; these are carried along with the running of the works. The small pipe account is composed principally of tools, gas pipe, brass work and fittings for small service work. Of course most of this will come back to the Company.

The resolution adopted by your honorable Board to put in small pipe, hydrants, etc., has had a beneficial effect in regulating prices for service connections, thereby increasing our applications for water consumption.

I have divided the gross expenditures of the construction of the works into three general heads, namely:

PUMPING WORKS AND RESERVOIR.

PIPE SERVICE.

INTEREST ON LOANS AND GENERAL EXPENSES.

PUMPING WORKS AND RESERVOIR.

REAL ESTATE.

Paid on account land purchased, - - - - - - - -	$4,176 00
Clearing ground, surveys, labor on river bank, tool room and road,	1,380 26

MACHINERY.

Paid Holly Company on account, - - - - - - - -	77,053 10
Freight, hauling and handling, - - - - - - - - -	3,511 61
	$80,564 71

ENGINE FOUNDATIONS AND CHIMNEY.

Labor,	1,579 12
Brick, sand, cement and lime,	2,332 69
Coping stone,	841 32
	$4,753 13

IRON PUMP WELL.

Excavating and lowering tube,	1,090 87
Plate, angle iron, and rivets,	4,061 29
Iron girders,	1,561 20
Boiler makers' work,	2,573 05
Lowering apparatus, hardware and iron,	698 95
Lowering truss and timber,	337 31
Masonry, substructure and filling,	165 00
	$10,487 67

TUNNEL.

Labor and material,	1,154 89

RIVER WORK.

Gravel Crib, Sheet Piling, Trench and Receiving Well.

Labor, all departments,	4,242 41
Lumber, timber, piles, etc.,	2,218 30
Brick, cement, etc.,	1,197 48
Hardware, iron, etc.,	1,076 14
Gravel for filling crib, washing, etc.,	306 61
Pile driving, pumping expenses, including coal, material and repairs on Pile Driver, etc.,	190 33
	$9,231 27

COAL HOUSE AND HOISTING GEAR.

Labor on building and tramway,	593 61
Lumber, timber, piles, fastening, etc.,	711 33
Coal skip, rope, blocks, etc.,	226 70
	$1,531 64

ENGINE AND BOILER HOUSE.

Brick, lime, cement and sand,	4,179 48
Lumber and timbers,	1,672 62
Windows, doors, hardware, etc.,	2,091 65
Excavation and grading,	442 92
Labor, Masons' department,	3,572 59
Labor, Carpenters' department,	1,325 70
Tin roof, gutters,	892 87
Painting,	310 10
	$14,487 93

RESERVOIR.

Excavation,	2,674 86
Labor on Embankment, Puddling walls, brick work, etc.,	2,535 29
Brick,	739 74
Inlet work, staging, etc.,	185 00
	$6,134 89
	$133,902 39

PIPE SERVICE.

Paid Gaylord Iron and Pipe Company on account,	$236,000 00
Paid Holly Company, for hydrants, on account,	10,000 00
Freight,	14241 80
Hauling pipe and specials,	1,219 83
Rutherford & Air, on account, trenching,	16,522 21
Trusses at Bayou crossing,	778 62
Valve covers, plugs, special castings and incidental expenses,	1385 17
Insurance on pipe and specials,	995 13
Paid Ludlow Valve Company on account,	8,600 76
Labor, laying suction and discharge main, deep trenching at works,	997 59
Running expenses, fuel, labor, etc., testing pipe,	970 15
	$291,711 11
Interest account,	$22,261 47

GENERAL EXPENSES.

Preliminary expenses in organization, Charter, etc.,	$11,000 00
Salaries, engineers and officers,	10,246 60
Advertising, stationery and printing,	1,166 25
Office rent,	450 00
Office furniture,	420 00
Office incidental expenses,	175 00
Agent's traveling expenses,	945 42
	$24,403 27

TOTAL EXPENDITURE OF CONSTRUCTION TO DATE.

Pumping works and Reservoir,	$133,902 39
Pipe service,	291,711 26
Interest account, and general expenses,	46.664 74
	$472,278 39

RUNNING ACCOUNTS.

Cash,	$4 083 29	
Six months' supply of fuel, oil, waste, etc.,	2,477 71	
Small pipe and specials,	2,983 53	
Meters,	121 00	$9,665 53
		$481,943 92
Footings Trial Balance, 1st April,		$481,943 92

I am unable to make an estimate of the probable revenue for the coming year, as applications are being rapidly added to our Register. Altogether the prospects are flattering for a much larger revenue the first year than we had expected, as many of our prominent citizens, who had not faith in our success and would not subscribe for water before we began operations, are now coming forward and promise to be our best customers. I have on record four hundred and thirty-six consumers, aggregating a revenue of some sixteen thousand dollars. The city has now in

her charge one hundred and eighty four fire hydrants, bringing in a yearly rent of twenty-one thousand, nine hundred and forty-six dollars and forty-five cents. I have adopted the plan of collecting all water rates up to the first of July, charging *pro rata* from the date the water is turned on to the customer's premises, which makes future bills fall due on the regular pay days established by the Company, namely: the first of July and January of each year, bringing in our collections in time to meet interest on bonds. This arrangement makes a smaller collection on first payment, but brings in more money by the tenth of July next than if we had collected for six months in advance at the start.

We are keeping over twenty men busy in putting in connections, consisting of street sprinklers, yard hydrants, and other outside supplies. I believe that the plumbers in the city have their hands full in making connections and doing indoor work for water consumption. Some portion of the amount charged to the small pipe account is comprised in the tools on hand for the purpose of doing the above mentioned work, and no inventory was taken, owing to the work being in progress. I will bring this item into my next report.

I must thank Mr. Pearsons, Engineer, for the assistance he has rendered me in keeping the expenditures of the different building departments in such manner as to give me the least possible trouble in this report in placing the items to their proper places. Mr. Riley, our street Superintendent, has kept a complete record of the pipe, its location, and the measurements from each cross Tee Valve, etc., which is one of the most important records in the office.

Yours, Respectfully,

W. L. CAMERON, *Secretary.*

RATES, RULES AND REGULATIONS.

YEARLY RATES.

Yard Hydrants, per room on premises	$ 1 50
No connection less than	6 00
Dwellings, per room	2 00
No connection less than	6 00
Bath Tubs, private, first	5 00
All others	2 50
Public	15 00
Water Closets, private, 1st	5 00
All others	2 50
Public	10 00
Urinal, private, first	5 00
All others	2 50
Public	10 00
Stores	6 00 to 25 00
Other rooms in same building will be charged according to occupancy.	
Business Offices	6 00
Banks & Insurance offices,	10 00
Saloons	10 00 to 50 00
Hotels & Boarding houses, special rates or meter rates	
Street & Yard Sprinklers, each 25 feet of lot	$ 5 00
Livery Stables, per stall	2 00
Private Stable, per stall	3 00
Work horse, mule and cow stable, per stall	1 00
Bakeries, per annum for each barrel flour used daily	5 00
Printing Offices, exclusive of engine	10 00 to 25 00
Building purposes, 10c per 1000 brick, and 50c per 100 yards of plastering.	
Steam Engines, per h. po'r	5 00
Breweries, for each barrel brewed	5
Restaurants	20 00 to 100 00
Barber shops, first chair	7 50
Each additonal chair	3 00
Fountains, for each 1-16 in. jet, running 7 mos. in the year, 4 hours a day	15 00
Inside fountains, special rates.	

METER RATES.

Up to 3000 gallons used per day	5 cents per 100 gallons.
From 3000 to 5000 gallons used per day	3 cents per 100 gallons.
From 5000 to 10,000 gallons used per day	2 cents per 100 gallons.
From 10,000 to 15,000 gallons used per day, and over	1½ cents per 100 gallons.

RULES AND REGULATIONS.

1. The tapping of main pipes to supply service pipes, for conveying water to the premises of consumers, shall in all cases be done by the agent of the Company; and the size of the connection with the mains shall in all cases be determined by the Company.

2. The Company will furnish the corporation cock, and charge the applicant for water a sum sufficient to cover the cost of the same, and the labor of inserting it in the main pipe.

3. Either lead or iron service pipe may be used, at the option of the applicant; and where lead is used, in the street or for inside plumbing, it must be that designated as "extra strong;" and all iron pipe to sustain a pressure of not less than 250 pounds to the square inch; and at the point of connection with the street main, between corporation cock and the coupling in the iron service pipe, there must be at least eighteen inches of lead pipe to relieve the rigidity of the iron pipe. A brass coupling must be used for connecting the lead with the iron pipe.

4. Notices for tapping the mains must be left at the office of the Company

by the plumber before 9 o'clock, A. M., of the day on which they are required, and must state definitely the location of the premises to be supplied, giving accurately the name and number of the street, and the name of the person to be supplied. Printed blanks for this purpose will be furnished at the office of the Company.

5. All service pipe must be laid at least three feet below surface of sidewalk or pavement, and kept in good repair at the expense of the owner or occupant; a suitable brass stop cock, with round water way, must be placed in the service pipe, to allow the Company to control the flow of water through said pipe, located inside the curb stone, and as near thereto as is practicable, with a cast iron box or pipe reaching from the stop to the surface, of suitable size, to admit a stop key for turning on and off the stop.

6. Said pipe or well to be securely protected from being filled up or obstructed, and covered with a cast iron cover, having the word "water" cast thereon; and if by any means it becomes filled up, so as to make it necessary to dig it up to procure access to the stop cock, it shall be at the expense of the applicant.

7. There shall likewise be placed in the service pipe within the wall of the building supplied, a brass stop and waste cock, easily accessible to the occupants, for the protection of said occupants, in enabling them to turn off the water in case of leaks, and to drain the pipes inside to prevent freezing, etc.

8. When the plumbing is completed and ready for use, application must be made at the office of the Company by the persons or parties who are to use the water; said application to state in writing the uses to which it is to be applied, fully and without reserve or concealment, and be signed by the persons or parties making the application; payment to be made for tapping the main pipe, furnishing and putting in the corporation cock, and in advance for the use of water, at established rates, to the next regular collecting day of the Company.

9. The above requirement being complied with, a permit will be issued and placed in the hands of the Inspector of the Company, who shall examine the plumbing, fixtures, etc., and finding said works and fixtures to correspond with the permit, and the works completed in accordance with the requirements of the Company, shall turn on the water and place the permit in the hands of the plumber having done the work, as evidence of the examination of the work by the Inspector, and that it is done in accordance with the rules of the Company.

10. If the Inspector shall find on examination that the water is to be applied to uses not enumerated in the permit, he will refuse to turn on the water and withhold the permit until the applicant corrects the application at the office.

11. The water cannot be turned on to any premises except by the Inspector or authorized agent of the Company; only as it may be turned on by the plumber to test his work, to be turned off immediately after the test is made.

12. No extension or alteration of any service pipe or fixtures can be made without written permission from the office of the Company.

13. Where more than one supply is made through one service pipe, and under control in the street of one stop cock, one person must make applications for all said supplies, and the bill will be made to said applicant for all the parties so supplied.

14. All leaks in service pipes in the streets, and in and upon all premises supplied, must be promptly repaired by the owner or occupant, and on failure to make such repairs with reasonable despatch, the Company will turn off the water from the premises until necessary repairs are made, and charge $1.00 for turning on again.

15 All willful waste of water or waste through neglect of servants or agents, or by fixtures out of order, or by allowing water to be taken from premises by persons having no right to its use, will be a sufficient cause for stopping the supply to any premises, and forfeiture of amount of bill paid in advance, or the withholding the supply for such time as the Company may decide.

16. No persons or parties supplied can allow any water to be taken from their premises without written permission from the office of the Company.

17. Street or yard sprinklers cannot be converted into jets or fountains, or be allowed to run to waste in the gutters of the streets, or upon lawns or in yards; but must be kept closed, except when used for sprinkling as intended.

18. All water bills will be paid semi-annually in advance, at the office of the Company, from the first to the tenth days of January and July, each year; and the supply of water will be stopped from all premises failing to comply with this requirement; and when turned off for non-payment of bills, $1.00 will be added to the bill for turning on again.

19. The Inspector or any authorized agent of the Company must have access at all reasonable times to all premises supplied, to examine fixtures, manner of using water, etc.

20. No connections from main pipes for plumbers to work from will be made for any persons who are not practical plumbers, and in whom the Company do not have confidence as men of experience and reliability; and repeated failures of plumbers to comply with the requirements of the Company will be sufficient reason to refuse to make connections for them to work from with the street mains.

21. Charter of the Memphis Water Company, Section 6:

"*Be it further enacted*, That if any person shall injure or destroy any portion of the works, fixtures or other property of the Company, such person or persons shall be liable to the Company for all damages sustained by them in consequence of such act or proceeding, and in addition thereto shall be deemed guilty of a misdemeanor, and on conviction thereof shall be fined in any sum not less than one hundred or more than one thousand dollars."

22. The right is reserved to amend or add to these rules and regulations, as experience may show to be necessary.

23. A list of the names of plumbers who will be permitted to work from the mains of the Company may be found at the office.